植物研究雑誌
J. Jpn. Bot.
82: 29–33 (2007)

Cytological Studies of the Genus *Carex* (Cyperaceae) in the Osumi Islands (Kagoshima Prefecture) I. Chromosome Counts of Five Species Collected from Yakushima Island

Okihito YANO[a], Taro NANAMI[b], Kumiko ITO[b], Hiroshi IKEDA[a, b] and Takuji HOSHINO[a, b]

[a]Department of Mathematical and Environmental System Science, Graduate School of Informatics,
Okayama University of Science,
1-1, Ridai-cho, Okayama-shi, Okayama, 700-0005 JAPAN;
E-mail: hoshino@big.ous.ac.jp
[b]Department of Biosphere-Geosphere System Science, Graduate School of Informatics,
Okayama University of Science,
1-1, Ridai-cho, Okayama-shi, Okayama, 700-0005 JAPAN

(Received on June 12, 2006)

Five species of the genus *Carex* collected from the Yakushima Island were subjected to karyomorphological analysis. Chromosome numbers of *C. atroviridis* (2n = 70), *C. morrowii* var. *laxa* (2n = 38) and *C. odontostoma* (2n = 30) were determined for the first time. Two taxa endemic to the Yakushima Island, *C. atroviridis* and *C. morrowii* var. *laxa*, had the same chromosome numbers as their allies, respectively. *Carex warburgiana* had a chromosome number of 2n = 28, which was new for this species. A chromosome number of 2n = 22 for *C. grallatoria* var. *heteroclita* corroborates previous reports. A dwarf type of *C. odontostoma* with a chromosome number of 2n = 30 was also found on the Yakushima Island. There were no karyomorphological differences between the dwarf and common types of *C. odontostoma*.

Key words: *Carex*, chromosome number, Cyperaceae, endemic, Yakushima Island.

The Japanese *Carex* are represented by over 200 species (Ohwi 1936, Akiyama 1955, Koyama 1962, Katsuyama 2005). While the chromosome numbers of several Japanese *Carex* species have been reported by Tanaka (1948), Hoshino (1981), Ohkawa and Yokota (1998) and Yano et al. (2006), few cytological studies on the representatives from the Osumi Islands have been undertaken to date. Accurate karyomorphological studies are important for understanding the evolution and diversification of this genus on the islands.

The Yakushima Island belongs to the Osumi Island group and is located approximately 60 km south from the mainland of Kagoshima Prefecture in Kyushu, Japan. Many vascular plants endemic to the island have been reported (Masamune 1934, Yahara et al. 1987), including representatives from the genus *Carex*. Masamune (1934) reported that eighteen taxa belonging to the genus *Carex* were to be found on the Yakushima Island, six of which were regarded as endemic to the island. Some time later Yahara et al. (1987) recognized three species, *C. atroviridis*, *C. morrowii* var. *laxa* and *C. yakushimensis*, as endemic to the island. In this paper the chromosome numbers of five species of the genus *Carex* from Yakushima Island are reported and relationships between the species and allies are briefly discussed.

Materials and Methods

Five species of the genus *Carex* collected from the Yakushima Island were used for karyomorphological observations. The materials examined are listed in Table 1. Of these, *C. atroviridis* and *C. morrowii* var. *laxa* have been reported to be endemic to the Yakushima Island (Yahara et al. 1987). Somatic chromosomes were observed in the meristematic cells of root-tips or shoot-apices, which were pretreated in 0.002 M 8-hydroxyquinoline solution for 1 h at 23°C and 15 h at 4°C. These were then fixed in acetic alcohol (1 : 3) for in excess of 16 h at –20°C or for 1.5 h at 23 °C, stained by Feulgen’s nuclear reaction, macerated in a mixture of 2 % pectinase and 2 % cellulase for 1 h at 37°C, restained in 1 % aceto-orcein and squashed. Voucher specimens were deposited at the Herbarium of Okayama University of Science (OKAY), Japan.

Results and Discussion

The chromosome numbers determined in this study are shown in Table 1. The numbers are reported for the first time for *Carex atroviridis*, *C. morrowii* var. *laxa* and *C. odontostoma*.

Carex atroviridis had a chromosome number of 2n = 70 (Fig. 1A). The somatic metaphase chromosomes were very small and were less than 1.0 μm in length. Ohwi (1936) reported that *C. atroviridis* is closely related to both *C. dolichostachya* and *C. multiflora* var. *multiflora*. The chromosome number of *C. multiflora* var. *multiflora* was also reported to be 2n = 70 by Hoshino (1981) and our results may suggest a close relationship between *C. atroviridis* and *C. multiflora* var. *multiflora*.

Carex grallatoria var. *heteroclita* was found to have a chromosome number of 2n = 22, confirming previous reports (Hoshino 1981). The somatic metaphase chromosomes ranged from 1.0 to 1.5 μm in length (Fig. 1B). The chromosome number for the typical variety *C. grallatoria* var. *grallatoria* was reported as being 2n = 18 by Tanaka (1948) or 2n = 17 and 18 by Hoshino (1981). These two varieties could be distinguished principally by their sexual characteristics, i. e., monoecious *C. grallatoria* var. *heteroclita*, vs. dioecious *C. grallatoria* var. *grallatoria*. Our results suggested that the two varieties could also be distinguished by cytological characteristics.

Carex morrowii var. *laxa* had a chromosome number of 2n = 38. Somatic metaphase chromosomes ranged from 0.9 to 1.6 μm in length (Fig. 1C). The chromosome number

Table 1. Species, localities and voucher specimens and chromosome numbers of five species of the genus *Carex* collected from Yakushima Island in Kagoshima Prefecture, Japan

Species	Locality and voucher specimen	Chromosome number (2n)
C. atroviridis Ohwi		
	Kumage, Kamiyaku, Mt. Miyanoura to Mt. Nagata, 1500 m alt.; Katsuyama & al. 19593 (OKAY)	70
C. grallatoria Maxim. var. *heteroclita* (Franch.) Kük.		
	Kumage, Yaku, Yodogawa-goya to Ko-hananoego, 1680 m alt.; Ikeda & al. 19440 (OKAY)	22
C. morrowii Boott var. *laxa* Ohwi		
	Kumage, Yaku, Hanaage River, 152 m alt.; Hoshino & al. 19423 (OKAY)	38
C. odontostoma Kük. (Common type)		
	Kumage, Yaku, Hanaage River, 156 m alt.; Hoshino & al. 19424 (OKAY)	30
C. odontostoma Kük. (Dwarf type)		
	Kumage, Yaku, Ko-hananoego to Mt. Miyanoura, 1680 m alt.; Ikeda & al. 19441 (OKAY)	30
C. warburgiana Kük.		
	Kumage, Yaku, Senpirono-taki, 225 m alt.; Hoshino & al. 19426 (OKAY)	28

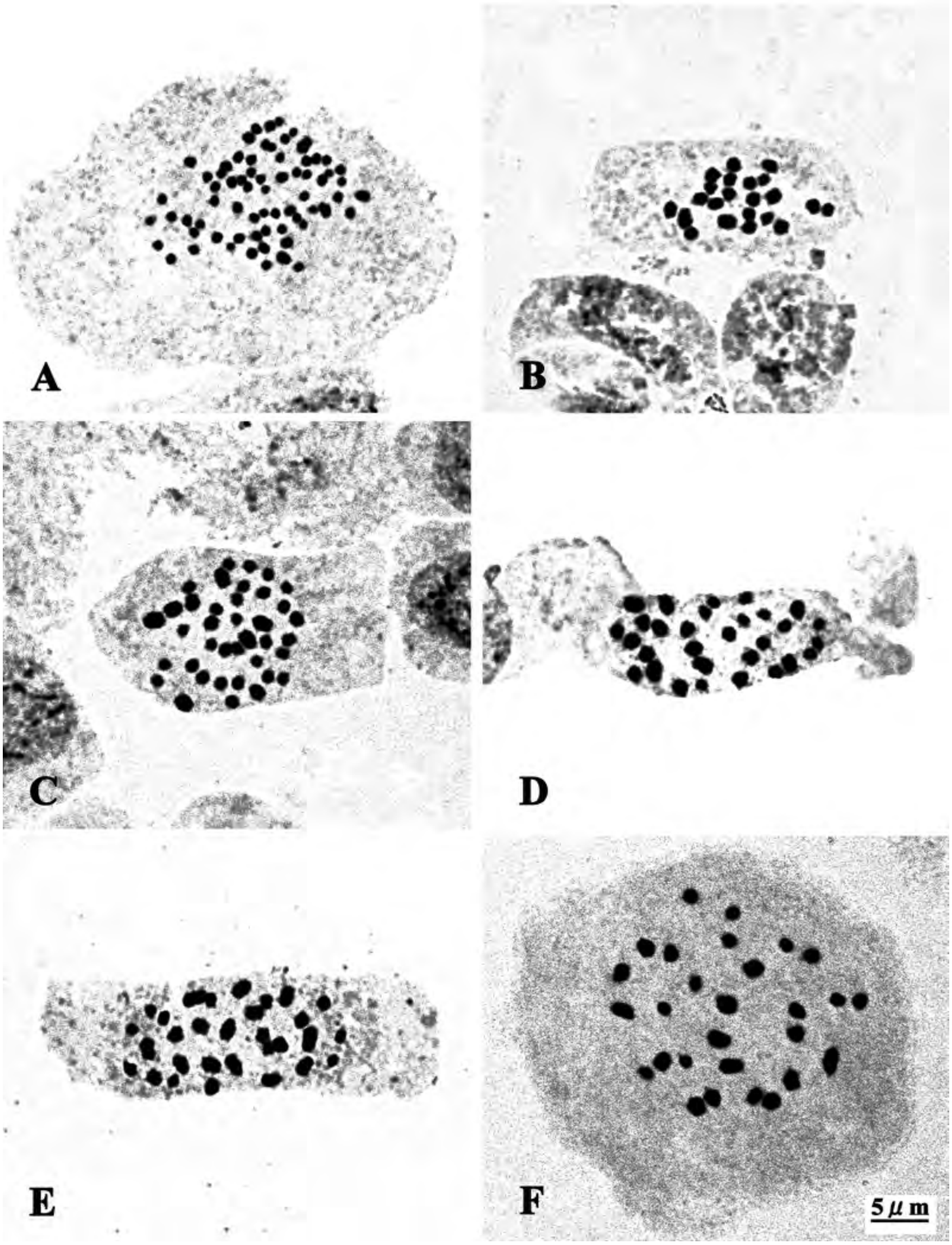

Fig. 1. Photomicrographs of somatic metaphase chromosomes of five species of the genus *Carex* from Yakushima Island. A. *C. atroviridis* (2n = 70). B. *C. grallatoria* var. *heteroclita* (2n = 22). C. *C. morrowii* var. *laxa* (2n = 38). D. *C. odontostoma* (common type) (2n = 30). E. *C. odontostoma* (dwarf type) (2n = 30). F. *C. warburgiana* (2n = 28).

Table 2. Comparison of the size of culms, leaves and spikelets of two types of *Carex odontostoma* from the Yakushima Island

	Dwarf type	Common type
Culm length	3.5–5.0 cm	20.0–45.0 cm
Leaf size	1.5–2.5 mm × 3.0–12.0 cm	2.5–3.5 mm × 10.0–50.0 cm
Pistillate spike length	0.5–1.0 cm	1.0–3.0 cm
Staminate spike length	1.0–1.8 cm	2.0–4.0 cm

of the typical variety *C. morrowii* var. *morrowii* was also reported as 2n = 38 by Tanaka (1948) and Hoshino (1981), and our results may support the treatment to recognize them as varieties of a species.

Many dwarf plants have been reported on the Yakushima Island (Sugimoto 1957), and the dwarf type of *C. odontostoma* were discovered on the Ko-hananoego to Mt. Miyanoura (1680 m alt.) in this study. Dwarf types are smaller than the common *C. odontostoma* in the size of the culms, leaves and spikelets (Table 2). The common type of *C. odontostoma* from the Hanaage river (156 m alt.) in the Yakushima Island was found to have a chromosome number of 2n = 30 (Fig. 1D). The somatic metaphase chromosomes ranged from 1.0 µm to 2.0 µm in length. The dwarf type of *C. odontostoma* also had a chromosome number of 2n = 30, and somatic metaphase chromosomes ranged from 1.0 µm to 2.0 µm in length (Fig. 1E). There were no karyomorphological differences between the common and dwarf types of *C. odontostoma*. *Carex odontostoma* belongs to section Ferrugineae, and has been seen as closely related to *C. chrysolepis* and *C. glabrior* (Akiyama 1955, Katsuyama 2005). The chromosome number of *C. chrysolepis* has been reported to be 2n = 28 (Hoshino 1981) and 2n = 30 (Tanaka 1948). Our results may suggest a close relationship between *C. odontostoma* and *C. chrysolepis*.

Carex warburgiana has a chromosome number of 2n = 28, which is new number for this species (Fig. 1F). The somatic metaphase chromosomes ranged from 1.0 µm to 2.3 µm in length. While *C. warburgiana* generally flowers in spring, all individuals from Yakushima Island were observed to flower in autumn (Katsuyama 2005). Katsuyama (2005) suggested that *C. warburgiana* in Yakushima Island may be a new taxon. Ohkawa and Yokota (1998) reported a chromosome number of 2n = 30 for *C. warburgiana* in three individuals from the Ryukyu Islands (Amamiohshima and Okinawa Islands). However, *C. warburgiana* in the Ryukyu Islands has been revised as being *C. tenuior* by Katsuyama (2005). *Carex warburgiana* belongs to section Ferrugineae and has been closely related to *C. makinoensis* (Ohwi 1936, Akiyama 1955) and to *C. tenuior* (Katsuyama 2005). The chromosome number of *C. makinoensis* has been reported to be 2n = 28 and 30 by Hoshino (1981). Our results may suggest close relationship among *C. warburgiana*, *C. makinoensis* and *C. tenuior*.

The authors thank to Mr. Teruo Katsuyama and Ms. Tomomi Masaki for their great help on field trips and in collecting plant materials. This study was partly supported by a Grant-in-Aid for Scientific Research (B) for the Japan Society for the Promotion of Sciences, no. 1440517 (to Hirokazu Tsukaya, National Institute for Basic Biology).

References

Akiyama S. 1955. Carices of the Far Eastern Region of

Asia. 257 pp. Hokkaido Univ., Sapporo (in Japanese).

Hoshino T. 1981. Karyomorphological and cytogenetical studies on aneuploidy in *Carex*. J. Sci. Hiroshima Univ., Ser. B., Div. 2, Bot. **17**: 155–238.

Katsuyama T. 2005. *Carex* of Japan. 376 pp. Bun-ichi Sogo Shuppan, Tokyo (in Japanese).

Koyama T. 1962. Classification of the family Cyperaceae 2. J. Fac. Sci. Univ. Tokyo Sect. III Bot. **8**: 149–278.

Masamune G. 1934. Floristic and geobotanical studies on the island of Yakushima. Mem. Fac. Sci. Agr. Taihoku Imp. Univ. **11**: 1–637.

Ohkawa T. and Yokota M. 1998. Chromosome numbers and their variation patterns of *Carex* in the Ryukyu Islands. Cytologia **63**: 447–457.

Ohwi J. 1936. Cyperaceae Japonicae. I. A synopsis of the Caricoideae of Japan, including the Kuriles, Saghalien, Korea and Formosa. Mem. Coll. Sci. Kyoto Imp. Univ. Ser. B Biol. **11**: 229–530.

Sugimoto J. 1957. On the pygmy plants of Yakusima Island. Shokubutsu-Shumi **18**: 2–10 (in Japanese).

Tanaka N. 1948. The Problem of Aneuploidy. Biological Contribution in Japan, 4. Hokuryukan, Tokyo (in Japanese).

Yahara T., Ohba H., Murata J. and Iwatsuki K. 1987. Taxonomic review of vascular plants endemic to Yakushima Island, Japan. J. Fac. Sci. Univ. Tokyo III, **14**: 69–119.

Yano O., Katsuyama T. and Hoshino T. 2006. Cytological studies of seven taxa of Cyperaceae collected from the Bonin (Ogasawara) Islands. J. Jpn. Bot. **81**: 98–102.

矢野興一[a]，名波太郎[b]，伊藤久美子[b]，池田　博[a, b]，星野卓二[a, b]：**鹿児島県大隅諸島産カヤツリグサ科スゲ属植物の細胞学的研究 I．屋久島より採集した 5 種の染色体数**

大隅諸島屋久島より採集したカヤツリグサ科スゲ属植物 5 種について染色体数を報告した．次の３種については今回が初めての報告で，ヤクシマスゲ（*Carex atroviridis*）が 2n = 70，ヤクシマカンスゲ（*C. morrowii* var. *laxa*）が 2n = 38，ミヤマイワスゲ（*C. odontostoma*）が 2n = 30 であった．このうち屋久島に固有のヤクシマスゲとヤクシマカンスゲは，それぞれ近縁群と同じ染色体数であった．また，ミヤマイワスゲの矮小タイプ個体は 2n = 30 であり，核型分析を行った結果，普通のタイプと差が認められなかった．バケイスゲ（*C. warburgiana*）では新たに 2n = 28 を観察した．サナギスゲ（*C. gallatoria* var. *heteroclite*）は 2n = 22 であり，従来の報告と一致していた．

（[a]岡山理科大学大学院総合情報研究科
数理・環境システム専攻，
[b]岡山理科大学大学院総合情報研究科
生物地球システム専攻）